Uploading Data for TPV105-2D
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Note: This document describes both 3D and 2D versions of the benchmark, but for now we are only doing the 2D version of the benchmark.

Part 1: On-Fault Time Series Data Files

Time series data is supplied as a set of ASCII files. You need to supply one file for each station. The 3D benchmark has 13 stations, and the 2D benchmark has 7 stations, as follows. Refer to the benchmark problem description for a diagram of station locations.

The 2D benchmark only uses the 7 stations located at a depth of 7.5 km.

On-Fault Stations for TPV105	
Station Name	**Location**
`faultst-120dp030`	On fault, -12.0 km along strike, 3.0 km down-dip.
`faultst000dp030`	On fault, 0 km along strike, 3.0 km down-dip.
`faultst120dp030`	On fault, 12.0 km along strike, 3.0 km down-dip.
`faultst-180dp075`	On fault, -18.0 km along strike, 7.5 km down-dip.
`faultst-150dp075`	On fault, -15.0 km along strike, 7.5 km down-dip.
`faultst-090dp075`	On fault, -9.0 km along strike, 7.5 km down-dip.
`faultst000dp075`	On fault, 0 km along strike, 7.5 km down-dip.
`faultst090dp075`	On fault, 9.0 km along strike, 7.5 km down-dip.
`Faultst150dp075`	On fault, 15.0 km along strike, 7.5 km down-dip.
`Faultst180dp075`	On fault, 18.0 km along strike, 7.5 km down-dip.
`faultst-120dp120`	On fault, -12.0 km along strike, 12.0 km down-dip.
`faultst000dp120`	On fault, 0 km along strike, 12.0 km down-dip.
`faultst120dp120`	On fault, 12.0 km along strike, 12.0 km down-dip.

Each time series file contains 11 data fields, as follows. For the 2D benchmark, the fields that refer to vertical motion or stress should contain zero (or very small values).

On-Fault Time Series Data Fields for TPV105	
Field Name	**Description, Units, and Sign Convention**
`t`	Time (s).
`h-slip`	Horizontal slip (m). Sign convention: Positive means **right lateral** slip.
`h-slip-rate`	Horizontal velocity (m/s). Sign convention: Positive means **right lateral** motion.
`h-shear-stress`	Horizontal shear stress (MPa). Sign convention: Positive means shear stress that tends to cause **right-lateral** slip.
`v-slip`	Vertical displacement (m). Sign convention: Positive means **downward** slip (that is, the far side of the fault moving downward relative to the near side of the fault).
`v-slip-rate`	Vertical velocity (m/s). Sign convention: Positive means **downward** motion (that is, the far side of the fault moving downward relative to the near side of the fault).
`v-shear-stress`	Vertical shear stress (MPa). Sign convention: Positive means shear stress that tends to cause **downward** slip (that is, the far side of the fault moving downward relative to the near side of the fault).
`n-stress`	Effective normal stress (MPa). Sign convention: Positive means **compression**. This is the effective normal stress, which is defined to be the total normal stress minus the pore pressure.
`psi`	State variable (dimensionless).
`temperature`	Temperature (degrees Kelvin). If you cannot supply temperature, then fill this field with the value 483.15 which is the initial temperature.
`pressure`	Pore pressure (MPa).

The on-fault time series file consists of three sections, as follows:

On-Fault Time Series File Format for TPV105	
File Section	**Description**
File Header	A series of lines, each beginning with a # symbol, that give the following information: • Benchmark problem (TPV105) • Author • Date • Code • Code version (if desired) • Node spacing or element size • Time step • Number of time steps in file • Station location • Descriptions of data columns (9 lines) • Anything else you think is relevant
Field List	A **single line**, which lists the names of the 11 data fields, in column order, separated by spaces. It should be: `t  h-slip  h-slip-rate  h-shear-stress  v-slip  v-slip-rate  v-shear-stress  n-stress  psi  temperature  pressure` (all on one line). The server examines this line to check that your file contains the correct data fields.
Time History	A series of lines. Each line contains 11 numbers, which give the data values for a single time step. The lines must appear in order of increasing time. **C/C++ users:** For all data fields *except* the time, we recommend using 14.6E or 14.6e floating-point format. For the time field, we recommend using 20.12E or 20.12e format (but see the note on the next page). **Fortran users:** For all data fields *except* the time, we recommend using E15.7 floating-point format. For the time field, we recommend using E21.13 format (but see the note on the next page). The server accepts most common numeric formats. If the server cannot understand your file, you will see an error message when you attempt to upload the file.

Note: We recommend higher precision for the time field so the server can tell that your time steps are all equal. (If the server thinks your time steps are not all equal, it will refuse to apply digital filters to your data.) If you use a “simple” time step value like 0.01 seconds or 0.005 seconds, then there is no need for higher precision, and you can write the time using the same precision as all the other data fields. When you upload a file, the server will warn you if it thinks your time steps are not all equal.

Here is an example of an on-fault time-series file. This is an invented file, not real modeling data.

```
# Example time-series file.
#
# This is the file header:
# problem=TPV105
# author=A.Modeler
# date=2011/01/31
# code=MyCode
# code_version=3.7
# element_size=100 m
# time_step=0.005
# num_time_steps=2400
# location= on fault, 9 km along strike, 7.5km down-dip
# Column #1 = time (s)
# Column #2 = horizontal slip (m)
# Column #3 = horizontal slip rate (m/s)
# Column #4 = horizontal shear stress (MPa)
# Column #5 = vertical slip (m)
# Column #6 = vertical slip rate (m/s)
# Column #7 = vertical shear stress (MPa)
# Column #8 = effective normal stress (MPa)
# Column #9 = state variable psi (dimensionless)
# Column #10 = temperature (K)
# Column #11 = pore pressure (MPa)
#
# The line below lists the names of the data fields:
# (Although rendered as two lines on this printed page, it must be one
# single line in the actual file.)
t  h-slip  h-slip-rate  h-shear-stress  v-slip  v-slip-rate  v-shear-stress
        n-stress  psi  temperature  pressure
#
# Here is the time-series data.
# There should be 11 numbers on each line, but this page is not wide enough
#  to show 11 numbers on a line, so we only show the first five.
0.000000E+00   0.000000E+00   0.000000E+00   7.000000E+01   0.000000E+00  ...
5.000000E-03   0.000000E+00   0.000000E+00   7.104040E+01   0.000000E+00  ...
1.000000E-02   0.000000E+00   0.000000E+00   7.239080E+01   0.000000E+00  ...
1.500000E-02   0.000000E+00   0.000000E+00   7.349000E+01   0.000000E+00  ...
2.000000E-02   0.000000E+00   0.000000E+00   7.440870E+01   0.000000E+00  ...
2.500000E-02   0.000000E+00   0.000000E+00   7.598240E+01   0.000000E+00  ...
# ... and so on.
```

Part 2: Contour Plot Data Files

The contour plot file lists the locations of all the nodes on the fault surface, and the time at which each node ruptures.

For TPV105, the contour plot file should include both the central velocity-weakening region and the transition region. The central velocity-weakening region measures 15 km by 30 km. When the transition region is added, the total size is 21 km by 36 km.

Each file contains three data fields, as follows. See the benchmark problem description for a diagram illustrating coordinates and sign conventions.

Contour Plot Data Fields for TPV105	
Field Name	**Description, Units, and Sign Convention**
`j`	Distance along strike (m). Sign convention: Positive means a location **to the right** of the hypocenter. For TPV105, the value of `j` can range from -18000 to 18000. Note: The central velocity-weakening region of the fault corresponds to values of `j` ranging from -15000 to 15000.
`k`	Distance down-dip (m). Sign convention: Zero is the earth's surface, and positive means **underground**. For TPV105, the value of `k` can range from -3000 to 18000. Note: The central velocity-weakening region of the fault corresponds to values of `k` ranging from 0 to 15000.
`t`	Rupture time (s). This is the time at which fault slip-rate first changes from zero to greater than 1 mm/s. If this node never ruptures, use the value 1.0E+09.

A pair of numbers `(j,k)` denotes a point on the fault surface.

The new contour plot file consists of three sections, as follows:

<table>
<tr><th colspan="2">Contour Plot File Format for TPV105</th></tr>
<tr><th>File Section</th><th>Description</th></tr>
<tr><td>File Header</td><td>A series of lines, each beginning with a # symbol, that give::
Benchmark problem (TPV105)
Author
Date
Code
Code version (if desired)
Node spacing or element size
Descriptions of data columns (3 lines)
Anything else you think is relevant</td></tr>
<tr><td>Field List</td><td>A single line, which lists the names of the three data fields, in column order, separated by spaces. It should be:

<code>j   k   t</code>

(on one line).</td></tr>
<tr><td>Rupture History</td><td>A series of lines. Each line contains three numbers, which give the <code>(j,k)</code> coordinates of a node on the fault surface, and the time <code>t</code> at which that node ruptures.

C/C++ users: We recommend using 14.6E or 14.6e floating-point format.

Fortran users: We recommend using E15.7 floating-point format.

If a node never ruptures, the time should be given as 1.0E+09.

Nodes may be listed in any order.</td></tr>
</table>

Note: The nodes may appear in any order. The nodes do not have to form a rectangular grid, or any other regular pattern.

Note: When you upload a file, the server constructs the Delaunay triangulation of your nodes. Then, it uses the Delaunay triangulation to interpolate the rupture times over the entire fault surface. Finally, it uses the interpolated rupture times to draw a series of contour curves at intervals of 0.5 seconds.

Here is an example of a contour-plot file. This is an invented file, not real modeling data.

```
# Example new contour-plot file.
#
# This is the file header:
# problem=TPV105
# author=A.Modeler
# date=2011/01/31
# code=MyCode
# code_version=3.7
# element_size=100 m
# Column #1 = horizontal coordinate, distance along strike (m)
# Column #2 = vertical coordinate, distance down-dip (m)
# Column #3 = rupture time (s)
#
# The line below lists the names of the data fields.
# It indicates that the first column contains the horizontal
#  coordinate (j), the second column contains the vertical
#  coordinate (k), and the third column contains the time (t).
j  k  t
#
# Here is the rupture history
6.000000E+02   7.000000E+03   3.100000E-02
6.000000E+02   7.100000E+03   4.900000E-02
6.000000E+02   7.200000E+03   6.700000E-02
7.000000E+02   7.000000E+03   1.230000E-01
7.000000E+02   7.100000E+03   1.350000E-01
7.000000E+02   7.200000E+03   1.470000E-01
# ... and so on.
```

Making a Contour-Plot File for a 2D Benchmark

In the 2D benchmarks, the faults are lines. But the web server expects the faults to be rectangles. So, for the 2D benchmarks you must “trick” the web server into believing that the faults are rectangles 21 km tall. To do this, each node on the fault line must appear twice in the contour-plot file: once with a vertical coordinate (k) of -3000, and once with a vertical coordinate of 18000. For example, if the node at location 4000 along-strike ruptures at a time of 4.26 seconds, you could place the following two lines in the contour-plot file:

```
4.000000E+03  -3.000000E+03   4.260000E+00
4.000000E+03   1.800000E+04   4.260000E+00
```